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Title: IMPROVEMENTS TO A CUTTING ATTACHMENT.

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1Improvements to a cutting attachment.

This invention concerns an improvement to a cutting attachment, more particularly to a cutting attachment for a robotic lawn mower.

5 Robotic lawn mowers are particularly suitable for the care of large lawn surfaces, for instance those of golf courses.

10 *Nd B/5* ~~Care of golf "practice courses", where players do their training and practice their "drive", is not easily taken by conventional means.] In fact, practices are covered with a number of balls thrown by players and all balls have to be picked up to allow mowing, to prevent both balls from being damaged and mowers from being jammed. Further, players have to stop any practice when lawns are mowed, to prevent any injury to the personnel, and this considerably limits the use of 15 the practice course.~~

20 Patent application no. PCT/BE96/00012 discloses a cutter disk having retractable blades, protected on its bottom face by another, substantially parallel, freely rotating disk. This cutter disk may be used with robotic lawn mowers such as those described in application no. PCT/BE98/00038, the motor-cutter disk

assembly being mounted in a flexible manner with respect to the chassis, so that it can follow ground irregularities.

S1 B 20 Nevertheless, this system is not suitable to mow a golf practice course, since it would itself cause damages to balls. In fact, retractable blades can come in contact with balls. Tests have been done by varying the cutting height, but balls remain a little suspended over the grass, as a function of the height and density of the lawn. As a result, even when mowing at a height above the diameter of balls, the latter are damaged.

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15 Therefore, there exists a definite need to develop a cutting attachment for mowing golf courses in the presence of golf balls, which is particularly adapted to automatic mowing of practice courses with no human intervention, and possibly even allows players to continue their practice.

20 To this end, this invention suggests an improvement to a robotic lawn mower, e.g. the one described in patent application no. PCT/BE98/00038, consisting of a cutting attachment which allows mowing in the presence of hard, small-sized objects, as compared to the cutting attachment, more particularly in the presence of golf balls, without damaging them.

25 According to the invention, the freely rotating disk or plate proposed in the above application is provided with extensions, or "prongs", which extend radially from its periphery so that balls or other equivalent objects may be maintained out of the reach 30 of the retractable blades, while allowing the latter to reach and cut the grass like in prior art. The system

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for suspending the cutting attachments allows the latter to be lifted. When the robotic lawn mower passes, the balls beneath the freely rotating disk are not touched by the blades. Friction is also reduced as compared to the fixed disk application, since the forward movement of the machine is coupled to the rotation of the disk in contact with the ball.

The other advantages provided by the presence of the disk as described in patent application no. PCT/BE96/00012 are maintained, particularly the self-cleaning and jam-preventing properties.

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To this end, it shall be noted that the addition of peripheral prongs to a not freely rotating disk involves a specific undesirable obstruction before the disk. This obstruction is caused by the collection of grass blades of variable length by the prongs as the machine advances. Thanks to the free rotation proposed according to one of the variants of the invention, the forwardly directed prongs are directed backwards after a half-turn, and the friction with the lawn grass causes said grass to be released and the pronged disk to be cleaned.

This change to the disk as compared to prior art also increases cutting system safety. When in contact with a living being or an object to be protected, the modified disk will prevent or strongly reduce any direct contact with the blades. Therefore, the device according to the invention might also be advantageously used in non robotic cutting devices (bush-cutters, mowers).

Hence, this invention proposes a cutting

attachment for a mowing machine, particularly for a lawn mower, comprising a motor whereof the driving shaft is linked to a cutter disk perpendicular to said shaft and provided at its periphery with at least one
5 blade, and a bottom plate substantially parallel to, and located beneath the cutter disk, characterized in that the bottom plate periphery has substantially coplanar extensions or prongs, extending radially beyond the zone reachable by the blades.

10 The bottom plate or disk is substantially circular and has a diameter, excluding the extensions, which is substantially equal to or smaller than the one of the cutter disk. By way of example, in the case of a robotic lawn mower, the cutter disk may have a smaller
15 diameter ("excluding the prongs") of 22 cm and an "outside" diameter of 29 cm.

The bottom plate is mounted freely on the cutter disk pin via a roller bearing, e.g. a ball bearing, or the like.

20 Extensions are provided in the form of prongs having a rounded profile (hollows and tips). The distance between two tips or ends of adjacent extensions ranges, for instance, from 2 cm to 5 cm. The number of extensions per bottom plate preferably ranges from 10 to 60, more preferably from 20 to 40.
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The cutting attachment is preferably linked to the chassis via a suspension system.

30 The cutting attachment will be preferably suitable for a robotic lawn mower, particularly for mowing golf courses, more particularly for mowing practice courses.

The invention will be understood more clearly

from the following description, with reference to one embodiment, and particularly to the drawings annexed by way of non-limiting examples.

Fig. 1 is a bottom view of the plate of a cutting attachment according to the invention.

Fig. 2 is a sectional side view of a cutting attachment mounted on a member of the chassis.

Figs. 3a through 3c show the operation of the cutting attachment in the presence of a ball according to prior art (Fig. 3a) and according to the invention (Figs. 3b-c).

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In Fig. 1 the bottom circular plate 3, freely rotating about the cutting axis 6, is recognizable. The cutter disk 2 is situated above the plate 3, and is driven by the motor, parallel to the plate. The cutter disk has three blades 1 at its periphery, which extend radially and can pivot freely about an axis of rotation 4 and retract thereafter beneath the cutter disk under the effect of an excessive resistance. (The bottom plate 3 (freely rotating protective disk) is provided with regular, coplanar extensions 33 at its periphery in the form of rounded prongs extending beyond the zone that the extracted blades can reach by the centrifugal force due to the rotation of the cutter disk.) The distance between two radial ends of the extensions is smaller than the size of the objects, in this case of golf balls. Balls are kept out of the reach of the free blades between two adjacent extensions. When the grass is cut balls are not touched by the blades.

As the robotic lawn mower advances, the cutter disk will pass over the balls, partly by free rotation

thereof, partly by friction.

According to a variant, which is currently less preferred, the ends of the extensions may be upwardly curved.

5 Fig. 2 shows more particularly a cutting attachment which is mounted in a well-known suspended arrangement (suspension rod 7, spring 17) on a member 8 of the chassis. The numeral 5 denotes the location of the ball bearing allowing free rotation of the
10 protective plate 3, all other numerals being equally provided in Fig. 1. It shall be noted that the extensions 33 of the plate 3 extend radially slightly beyond the extracted blades 1.

15 Figs. 3a-b show the contact between the cutting attachment and a spherical object, e.g. a golf ball. In Fig. 3a, the cutting attachment is a prior art cutting attachment. As the lawn mower advances, the ball 9 is damaged in 10 by the rotating blades 1, before passing under the "floating" cutting attachment, totally in
20 friction, particularly under the freely rotating plate 3.

25 Figs. 3b and 3c show the contact between the cutting attachment of the invention and a golf ball. The extensions 33 of the plate 3 prevent the blades from contacting the ball, which will advantageously pass beneath the freely rotating plate, while the cutting attachment is lifted. At the same time, the ball itself will generally sink to a certain extent into the grass, and will pass beneath the plate with a
30 minimized friction (Fig. 3c).

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